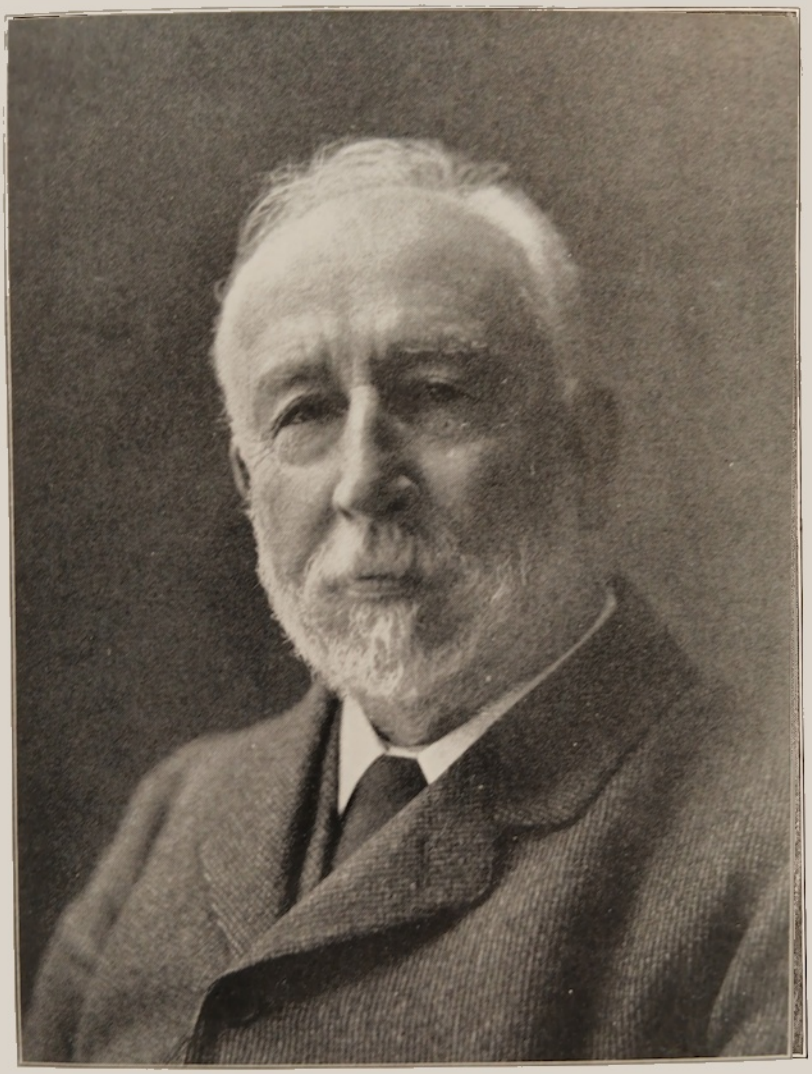

SIR DAVID GILL

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SIR DAVID GILL

By J. C. KAPTEYN

Such are the salt of the earth.[1]

On January 24 died in London, at the age of seventy years, Sir David Gill, formerly Her Majesty's astronomer at the Observatory at the Cape. In him science loses the foremost practical astronomer of the age. Only a few months before his death he crowned his life's work by the completion of his *History and Description of the Royal Observatory, Cape of Good Hope*. This publication gives the fullest existing description of his life and his work. About his youth we read:

The eldest surviving son of David Gill of Blairythan, Aberdeenshire, I was born at Aberdeen on the 12th of June, 1843, and attended the Bellevue Academy at that city till about the age of fourteen, when I went to Dollar Academy and came under the inspiring influence of Dr. Lindsay, at whose house I boarded. His teaching filled me with the love of mathematics, physics, and chemistry.

From Dollar I proceeded to Marischal College and University, Aberdeen, where I was a student under the celebrated Clerk Maxwell, and his teaching influenced the whole of my future life. My father had married late in life, for at the time I was twenty years of age, he was seventy-four years old. He was a successful merchant in Aberdeen, as had been his father before him, and he not unnaturally wished me to succeed him in business. I very unwillingly yielded, and, after some years, my father retired, leaving his business in my

[1] These words were applied to Gill by the famous General Gordon.

hands. My heart and my thoughts, however, had always been set upon things scientific. From the time that I entered college, I had a little laboratory in my father's house where I made chemical experiments, and, later, under Clerk Maxwell's influence, carried out preliminary essays on the determination of physical constants.

Gill then goes on to tell how in 1863 it occurred to him that Aberdeen was very much in need of a standard of accurate time and how the desire of satisfying this need brought him to Edinburgh, where he was for the first time introduced to an astronomer and to an observatory, and how on his return he, together with Professor Thomson, unearthed, mounted, and adjusted a portable transit instrument at what had been called "an observatory" at King's College.

Already, at this early date, the qualities which stand out so prominently in his future career become apparent. He cannot rest before at least a couple of clocks at Aberdeen are electrically controlled to show accurate Greenwich Mean Time; and no sooner has this end been attained than he is looking out for a wider field of action. A twelve-inch silver-on-glass speculum is purchased, for which he designs an equatorial mounting. The driving clock, too, was made by his own hands and turned out to be "as satisfactory a driving clock as I have ever known." The instrument was employed

in measuring double stars, examining nebulae, making photographs of the moon, and generally in satisfying my curiosity as to the wonders of the heavens, and I had just begun to plan attempts to determine the parallaxes of some stars with a micrometer by Steinheil of Munich, when I received a visit from Lord Lindsay (now the Earl of Crawford). He was then considering the question of creating an observatory at his father's seat, Dun-Echt, about thirty miles from Aberdeen. He had seen some of my photographs of the moon, and desired to examine the means I employed for the purpose. Our acquaintance rapidly ripened, and he became aware of my desire to devote my time exclusively to science. One fine day in 1872 I received a letter from his father, the Earl of Crawford and Balcarres, offering me charge of the observatory which his son was about to erect at Dun-Echt.

It seems almost a pity that the visit from Lord Lindsay did not come a couple of years later. It might have given us the spectacle—unique in the annals of science—of a business man measuring star-

parallaxes in his leisure hours. Meanwhile, even so, he had before him a task which might have deterred almost any experienced astronomer—the task of planning and discussing the details for the several instruments and their respective observatories, for their testing, mounting, and adjusting, besides making preparations for Lord Lindsay's expedition for the observation of the transit of Venus at Mauritius in 1874. When the time for the expedition had come, we find him traveling all alone with fifty chronometers.

> Before my visit to Greenwich I had no misgiving as to the success of the arrangements. But when Sir George Airy and his assistants came to wish me goodbye and when they saw me go off with all the chronometers on the top of two cabs, and no one but myself to look after them, it was evident that they regarded the whole matter as an experiment of very doubtful success and did not envy the task before me. A first suspicion of these difficulties dawned upon me at the time, and they were fully realized before the expedition was over. Incessant watchfulness was necessary, and the anxiety connected with every move on shore and every embarkation or landing of the instruments was excessive, especially at places like Suez, Alexandria, Aden, and Mauritius, where only colored labor was available. But all ended well.

We may pass over the results obtained for longitude, which were fully successful. The main interest attaching to the expedition is the heliometric determination of the solar parallax by means of observations of Juno. Unfortunately the late arrival of the heliometer, and cloudy weather, permitted observations only on 12 evenings and 11 mornings, all of them some time after the opposition. The value of the determination, therefore, lies not so much in the result obtained for the solar parallax as in the fact that it furnishes "sound data on which to found calculations as to the value of the opposition of any minor planet for the future determination of the solar parallax."

On the way back from Mauritius we find Gill, at the request of the chief of the military staff of the Khedive, measuring a base line for the projected survey of Egypt. Concerning the particular difficulties of this measurement, owing to the unfitness of the assistants, we must refer to the *History of the Cape Observatory*. Still time was found to make some observations, together with Dr. Döllen, in order to determine the deflection of the plumbline produced by the attraction of one of the pyramids.

In 1876 Gill left Dun-Echt. In 1877 he made his celebrated expedition to Ascension for the heliometric observation of the opposition of Mars. On this expedition he was accompanied by his wife, to whom he had been married in 1870. The costs of the expedition were borne by the Royal Astronomical Society and the Government Grant Fund of the Royal Society. There is a delightful description of the expedition by Mrs. (now Lady) Gill in *Six Months in Ascension*, from which a few sentences may be here quoted.

> On July 17 the observatory had been ready for duty; but no sooner were the instruments adjusted and some preliminary observations made, than the face of the heavens darkened and we began to fear. . . . . Many hours, indeed whole nights, this went on, and sometimes the clouds followed each other so rapidly that no measures could be secured at all. . . . . Fearful of losing one hour of starlight during the night, we watched alternately for moments of break in the cloud, sometimes with partial success, but more frequently with no result but utter disappointment, and the mental and physical strain, increasing every night, grew almost beyond our strength . . . . when one day David spoke and took away my breath. He said, "Let us prove how far this cloud extends and find out whether there is any accessible part of the island *not* covered by it."

As the clouds appeared only at night, the investigation had to be made in the darkness. Gill could not leave his post, and no choice was left him but reluctantly to accept the persistent offer of his wife to go on an exploration herself. Simultaneous observations of the clouds were arranged, and the result of the trying expedition was the conviction that the cloud was systematic and that the chances of clear weather would be much better on the southwest point of the island. But the point would be hard to reach either by sea or by land.

> Both routes seemed dangerous—the land route indeed impossible, while the surf and rollers which beset the Ascension coast gave little hope of the sea. No landing had ever been made at this bay. . . . . Oh, the sickening responsibility of making up one's mind and choosing between two evils. . . . . Either way looked gloomy. On the one hand my husband felt, if I stay here and fail, I shall have failed also in my duty, not having done my utmost. On the other hand, every night is now of importance, and a week is lost *certainly* if I pull down the observatory, while the slightest accident to an instrument here, with no one to repair it, will be fatal to the expedition.

> Yes! both "ifs" were unpleasant, but the first was intolerable, and after a day of anxious thought David made up his mind that an attempt to reach South Point must be made. . . . .
>
> It was on the 31st of July that the important decision was made, and, strange to say, that same night in Garrison, my husband was able to make his first complete determination of the parallax of Mars.
>
> The sky was cloudless from sunset to sunrise, and I wavered, wondering, as many others did, whether the new hope would shake the new decision; but when I questioned, the answer was: "The man that hesitates is lost."

The removal of the observatory was achieved, not without great difficulty, but without serious accident. On August 5, five days after the last successful observations at Garrison, good evening and morning observations were secured at Mars Bay. The expedition was saved from failure.

The few lines quoted, besides throwing light on Gill's character, give a glimpse of his married life. All who knew him know what marriage meant to him. In doing homage to the man, they see, by his side, his highly gifted wife—the wife who made his happiness; who by her infinite, unselfish devotion encouraged and sustained him in every difficulty, and who, though in later life failing in health, still knew how to cheer him in moments of discouragement. To her is due not a little of the homage paid to her great husband.

In 1879 Gill became Her Majesty's astronomer at the Cape, a post which he filled for twenty-eight years. It is there that his real life's work was done. To give a satisfactory account of it, even as briefly as we did for his earlier work, is of course out of the question here. We dwelt somewhat longer on this early work only because it already shows clearly the mettle of the man apart from the co-operation of any assistants. The indomitable energy, love of work, and respect for duty which characterize the beginner leave little doubt as to what—given the necessary health—may be expected from the man when a wider scope is given to his activity. How this expectation is fulfilled is seen at once, if we compare what the observatory and the range of its activity were at Gill's appointment in 1879 and at his resignation in 1907.

In 1879 the only astronomical instruments available for observation were the non-reversible transit-circle, the 7-inch equatorial, and the photo-heliograph. Accordingly the work of

the observatory consisted in the observation of comets, a few double-stars, but in the main in meridian determinations.

Under Gill were added: the 4-inch heliometer (obtained by private purchase), the 6-inch refractor, the 7-inch heliometer, the astrographic telescope, the 24-inch Victoria telescope (gift of Mr. Frank McClean), the reversible transit-circle, the 3-foot altazimuth (loaned permanently to the Cape Observatory by the Trigonometrical Survey of India), and the zenith telescope.

Together with this increase of the astronomical outfit, the staff was gradually extended. The observatory had become an astronomical institution of the first rank. Hardly a problem of practical astronomy was left untouched, and no effort was spared to bring the knowledge of the southern sky more nearly on a par with that of the northern. Of course the meridian work was not neglected. On the contrary, not only were the observations made, the results of which are embodied in the *Cape Catalogues* for 1885, 1890, and 1900, but there were, besides, the *Cape Catalogue of Astrographic Standards*, containing 8560, and the *Cape General Catalogue* for 1900 with 4464 stars. Moreover, the arrears in the reduction of the older observations, already partly cleared off by his predecessor Stone, were finally brought to an end, furnishing the materials for the *Cape Catalogues* of 1850 and 1865. And last, but not least, Gill worked out the plans for and erected the new reversible transit-circle with its observatory and accessories, which places the Cape Observatory in the front rank for refined meridian work.

But along with the meridian work what a series of other labors! A few words may be devoted to two of them.

Researches on stellar parallax.—Twenty-two stars have been measured for parallax, either at the 4-inch or at the 7-inch heliometer. They are the only reliable determinations of stellar parallax ever made in the Southern Hemisphere. It might almost be said that they are the first parallaxes, or at least the first extensive series of parallaxes, which command the entire confidence of the astronomers. The gain in probable error may not be so considerable. The gain in real reliability is very great. In fact, in the domain of stellar parallax, as indeed also in that of the solar paral-

lax, Gill has given us back our belief in probable errors, a belief which, among astronomers, had given way to a pretty general skepticism.

Why this is so is not a matter of doubt. No one can study Gill's work without feeling that he has to do with the born observer, the man with the intuitive faculty of finding out every possible source of systematic error and with the unerring judgment in devising means for its removal; the man with the instinctive feeling for perfect symmetry by which all errors known or unknown must be eliminated. As a consequence we find Gill never satisfied with his work, as long as in any part of it the agreement of the several results is markedly inferior to what might be expected from the probable errors. It cannot be doubted that by the example thus given of a perfect arrangement of the observations and their exhaustive discussion, Gill has contributed to the advancement of science quite as much and more than by the results of his observations themselves.

Researches on the solar parallax.—The problem of the sun's distance has seen some curious vicissitudes during the nineteenth century. In the first half of that century the best values (excepting perhaps that of Henderson) ranged between the narrow limits 8.55 and 8.63, so that the value 8.571 found by Encke from the transits of Venus in 1761 and 1769 seemed to solve the problem of the sun's distance in a satisfactory way. Then in 1854, Hansen, from the parallactic equation, found 8.87 and Leverrier shortly afterward, from the lunar equation of the earth, 8.95. After that, till the time of Gill's first determination, one determination was published yielding the value 8.77, two giving 8.79, all the rest ranged from 8.83 to 8.97.[1] Toward the end of the period under consideration a great effort was made by most of the civilized nations to put an end to this discouraging uncertainty in one of the most fundamental constants of astronomy, by numerous expeditions for the observation of the transits of Venus, in 1874 and 1882. As a matter of fact, however, the problem has been solved, not by these expeditions, but by Gill's labors.

[1] According to Newcomb, "Synopsis of Papers on the Solar Parallax, 1854–1877," *Popular Astronomy* (1878), p. 538.

The determinations by means of his heliometer observations of Juno and Mars, already mentioned, are in a certain sense only preparatory.

In an admirable paper written in 1877 (*Observatory*, Vol. 1), Gill reviews all the available methods. He comes to the conclusion "that only the observation of minor planets entirely fulfils the conditions . . . . as containing within itself the means of eliminating all possible sources of error." The experience gained by the heliometric observations of Juno enables him to conclude that "four reasonably favourable oppositions of favourable minor planets will give the solar parallax with all the accuracy required by the present state of science, provided they are observed with a first-rate heliometer, by an experienced observer, in a good station."

It was not in Gill's nature to wait till others should work out the program thus laid down. "Whenever he set his hand to any bit of work," says the president of the Royal Astronomical Society (H. F. Newall) in presenting to Gill the gold medal of the society in 1908 (the second gold medal of the society awarded to him), "it became the dream of his life to see that particular bit of work completed in the most comprehensive way that he could attain."

Besides if for any man, then for Gill, held the definition of Molenschott, "difficulties are things that are overcome." So it was in the present case. No sooner had Gill been appointed Her Majesty's astronomer than he set to work to plan for the acquisition of the necessary instrument.

In March 1887 I had the pleasure of accompanying him to Hamburg. After a fatiguing journey, we arrived only a little before midnight. Repsold was there to meet us. He told us that early on the next morning everything would be in order, so that Gill might inspect the 7-inch heliometer which had just been completed. Gill would not hear of such a thing. "I can but give you the time necessary for reading my letter. After that we *must* see the heliometer." And we saw it, and when he had inspected every detail, turned every handle, read every microscope, he burst out: "Well, aren't you jealous? Why, I wouldn't be half as happy as I am, if you weren't." Not many weeks later the instrument was mounted at the Cape, the most efficient instrument of the sort in existence. Of course, regular experimental observations were

begun "without delay." In February 1888 it was in regular use for stellar parallax. Before the end of the year it was employed in observations on the minor planet Iris; by the middle of the next year on Victoria and Sappho. "One very noteworthy and delightful feature connected with these researches was the enthusiasm and goodwill with which astronomers of all parts of Europe and America responded and took part in the program of the observations."

The labor involved, both in the observations and in the reductions, was enormous, the success complete. The results obtained by the three planets agree within their probable errors. They agree with the value derived by Auwers from the meridian observations of the planet, and with the values yielded by the Juno and Mars expeditions in 1874 and 1877. They have been found later to agree perfectly with the results of the observations of Eros. Still Gill's enthusiasm for the problem was in no way exhausted.

Already in 1891 he was revolving in his mind a plan of deriving the solar parallax by the observations of the radial velocities of bright stars somewhat near the ecliptic. The method has been applied for the first time by Küstner in Bonn in 1904–1905. At the Cape a series of determinations was begun during the time of Gill's directorate. The investigation was carried to completion in an admirable way under his successor. The result is in complete agreement with that of the minor-planet campaign. In 1909 the thing which, perhaps more than anything else, made him insist on having another meeting of the Comité Permanent of the astrographic chart, was the preparation for the opposition of Eros in 1931!

It is with reluctance that we must confine ourselves to saying so much—rather so little—about only two of Gill's great undertakings. An enumeration of some of the other works must suffice, several of them of no less importance and of far greater extent: *The Cape Photographic Durchmusterung;* the revision of the *Cape Photographic Durchmusterung; Determination of the Mass of the Moon; Determination of the Mass of Jupiter and the Elements of the Orbits of the Older Satellites; The Parallax of the Moon;* investigation of the positions of close circumpolar stars; *Double Stars;* astrophysical observations. *The Heliometric Determination of the Positions of the Major Planets; the International Astrographic*

Chart and Catalogue, and, last in order, what is probably first in importance, *The Geodetic Survey of South Africa*. Only a few words must be said about the *Astrographic Chart and Catalogue*. The initiative for this great undertaking is due to the joint action of Gill and Admiral Mouchez, the director of the Paris Observatory, aided by the brothers Henry. What the whole undertaking, not only at starting, but during the whole of its progress, owes to Gill's untiring energy, all will know who attended the meetings of the Comité Permanent. Up to the last, his was the great driving force.

In the very last meeting of the committee, the most important resolutions taken are undoubtedly those relative to the fundamental, intermediate, and standard stars. It is well known that Gill is really father to these resolutions, though his name does not appear. How different everything will be at the future meetings, when Gill will not be there! How different would be the outlook now, if he could have carried through his plan for a central bureau, perhaps the only important measure which he failed to see brought about!

Outsiders who have seen him at work at these congresses may have been under the impression that it was the geniality of his person, his infectious enthusiasm, and strong self-reliance which carried the day. But those who had followed matters closely would know how carefully he had studied every detail of the matter to be discussed, how long beforehand he had extensively corresponded with the most capable and most interested persons, and how he brought many of them together a few days before the date of the congress, not only to arrange the program for the proceedings, but also to discuss informally all the main points. All during the congress, too, he would bring the ablest men together for these informal discussions. In these Gill would always play a prominent part; sometimes his impetuosity would make it far from easy for those opposed to his views to explain their standpoint. It might be some time before Gill would really give attention to what they had to say, but that moment having come, they could wish for no better listener, and if they succeeded in showing that their point of view was more nearly correct, no man would be

quicker to recognize his error than Gill. No man could be long with him without feeling that here was a man to whom the real interest of science was paramount, a man who was always ready to sacrifice any pet plan of his own to the real interest of astronomy. A favorite expression of his, in giving up his opinion, would be: "The man who never makes a mistake is he who does nothing." I cannot help thinking that such personal qualities—his indomitable energy, his broad-mindedness, love of his work, kindness—his manliness in the best sense of the word, in short the charm of his strong personality, had almost as much to do with his achievements as his qualities as a scientist.

The ready response to any appeal of his for international co-operation must, of course, in great part be ascribed to the soundness of the plan, and the confidence inspired by the qualities of the observer, but the personality of the man must have contributed not a little. It is hardly too much to say that in the minor-planet campaign all the active heliometers and meridian circles of the world took part.

More clearly, probably, we see this influence in the voluntary aid given by so many individuals. Well known is the part that Elkin took in the stellar parallax work. So is Innes' work on the double stars and on the revision of the *Cape Photographic Durchmusterung;* Auwers' timely and invaluable aid in the taking of the heliometer observations for Victoria and his reduction of the Meridian observations; Jacoby's part in the triangulation of the Victoria stars; De Sitter's and Cookson's highly important contributions to the observation and discussion of the Jupiter satellites, as also the work of the Groningen Laboratory on the *Photographic Durchmusterung*. The list must be incomplete. Still we ought perhaps to add the work done under the hospitable roof of the Cape Observatory by McClean and Franklin-Adams—work, indeed, which formed no part of the labors undertaken by the observatory, but which still greatly benefited our knowledge of the southern sky, and might not have come about without Gill's help and encouragement.

As a scientist Gill is best comparable in my opinion to F. G. W. Struve. The terms in which Argelander sums up his

character-sketch of Struve in the *Vierteljahrsschrift der astronomischen Gesellschaft* (1, 52) are applicable almost word for word to Gill. And might not the following words be applied to Gill's *History of the Cape Observatory:* "There is inspiration to be found in nearly every page of it, for its author had the true genius and spirit of the practical astronomer—the love of refined and precise methods of observation and the inventive and engineering capacity": As a matter of fact they were written *by* Gill *about* Struve. Even in the particulars of their careers there is the greatest parallelism.

In the annals of astronomy, Gill's name will take place with those of Bradley, Bessel, and Struve. In many a human heart his image will last as long as life itself.

GRONINGEN
May 1914